



# ESD

## Exploration Systems Development

Combined Monthly Report June 2016

### Orion:

Orion Discovers 'Strange New Worlds' .....	3
Orion's Service Module Completes Critical Design Review .....	5
Ohio Suppliers Commended by Senator Portman .....	7
Orion and SLS Programs Thank Alabama Workforce ..	8
Plum Brook Station: Powering Up .....	10
Reliable, Legacy Engine to Power Orion .....	11
3D Scanner Provides As-Built Service Module Engine Measurements .....	12
NASM Hosts Space Day Event .....	12
Top Students Learn from NASA .....	13
Express the Explorer in You .....	14

### Space Launch System:

Space Launch System Booster Passes Major Milestone on Journey to Mars .....	16
Snapshot of SLS Booster Test .....	17
QM-2 Social Snapshot .....	18
Hardware for NASA's Journey to Mars .....	19
NASA in the Park .....	19
Faces of SLS: Janica Cheney .....	20
Spaceflight Partners: Metalex Inc. ....	20
Michoud 'Tanks' Up for Nasa's Deep Space .....	21
Bill Nelson Sees Manufacturing of SLS Fuel Tank ....	21
SLS Hits a Home Run with Baseball Fans .....	21
SLS Visits Ohio and Alabama Partners .....	22

### Ground Systems Development & Operations:

NASA's Ground Systems Puts Students 'FIRST' .....	23
Ground Systems Team Spotlight .....	24
Industry Spotlight: Precision Fabrication Cleaning ...	25
Employee Spotlight: Joy Mosdell .....	26





National Aeronautics and  
Space Administration



# ORION

JUNE 2016

# OUT OF THIS WORLD!

Natalie Oluwo, as Undyne from Undertale, gives Orion's PORT mockup a thumbs up at Comicpalooza.



A large Orion spacecraft mockup is being transported on a multi-lane highway. The mockup is a cone-shaped capsule with a NASA logo and an American flag. It is mounted on a trailer and is being towed. In the background, a city skyline with several tall skyscrapers is visible under a blue sky with some clouds.

# ORION DISCOVERS 'STRANGE NEW WORLDS' AT COMICPALOOZA

Science fact met science fiction as NASA and the Orion team created an out-of-this-world exhibit at this year's Comicpalooza, held June 17-19 at the George R. Brown Convention Center in Houston.

Prior to the event, people around Houston shared their surprise and excitement to see a full-scale Orion mockup heading up the freeway as it was transported from NASA's Johnson Space Center to Comicpalooza. The Orion Post-landing Orion Recovery Test (PORT) mockup is used to train astronauts for Orion ingress and egress maneuvers in the Neutral Buoyancy Lab. Snapshots of the spacecraft posted online throughout the weekend catapulted #SpotOrion posts to 22 million impressions around the world.

The PORT attracted the cast of characters at Comicpalooza to strike a pose with America's first interplanetary spacecraft for humans that will boldly go where no one has gone before as it takes astronauts far beyond the moon to explore our solar system.

*Continued on next page.*







Like the Silver Surfer, Orion will don a shiny new coating for its exploration missions which will provide better thermal protection for the spacecraft components and crew.

At the event, Orion engineer Nujoud Merancy briefed a standing-room-only crowd on how astronauts will live and work in space aboard the Orion spacecraft and deep space habitats during her talk “Journey to Mars: Home Sweet Habitat.”

To read more about Orion at Comicpalooza, view the links below:

[bit.ly/OrionTravelsHouston](http://bit.ly/OrionTravelsHouston)

[bit.ly/SpotOrion](http://bit.ly/SpotOrion)

[bit.ly/Orion\\_on\\_Freeway](http://bit.ly/Orion_on_Freeway)

[bit.ly/OrionlandsatComicpalooza](http://bit.ly/OrionlandsatComicpalooza)

[bit.ly/WhereInTheWorldIsOrion](http://bit.ly/WhereInTheWorldIsOrion)

[bit.ly/Driving\\_Orion](http://bit.ly/Driving_Orion)





# ORION'S SERVICE MODULE COMPLETES CRITICAL DESIGN REVIEW

NASA and ESA (European Space Agency) conducted a critical design review (CDR) culminating in a final review board June 16 for Orion's European-built service module. The service module is an essential part of the spacecraft that will power, propel, and cool Orion in deep space as well as provide air and water for crew members. The CDR rounds out the latest in a series of reviews for the three human exploration systems development programs that will enable the journey to Mars.

During the review process, technical experts examined the module designs and numerous items were processed and closed out, giving engineers confidence the module design is mature enough to continue with fabrication, assembly, integration and testing.

The recently completed review focused on the overall service module design while discussing differences between Orion's first deep space mission atop the Space Launch System (SLS) rocket and the mission to follow that will carry crew. No new major issues were identified during the review, and the teams worked together to develop a plan for work going forward in areas such as power, solar array management and propellant usage.

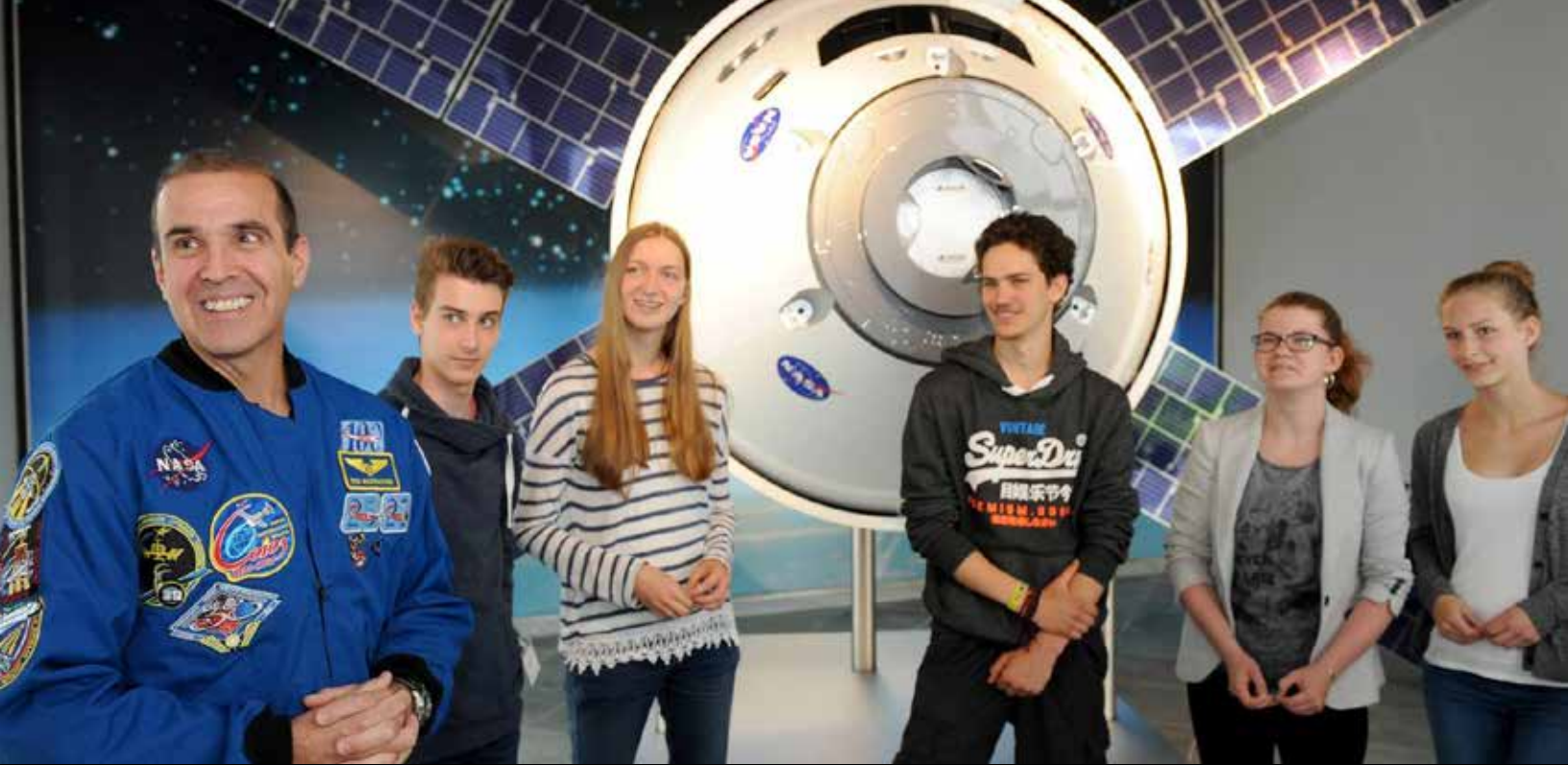
The review was conducted at ESA's European Space Research and Technology Centre in Noordwijk, Netherlands with teams from NASA, ESA, Lockheed Martin and Airbus Defence & Space in Bremen, Germany. Lockheed Martin is NASA's main contractor building Orion, and Airbus is ESA's contractor for the service module.

The CDR identified April 2017 as the target for the service module delivery to Kennedy Space Center in Florida. Teams will begin integrating hardware into the rocket before the service module is delivered, and NASA plans to continue to optimize processing when it arrives at Kennedy. Initial results maintain EM-1 launch date no later than November 2018.

Read the full story at: [bit.ly/ServiceModule\\_DesignReview](http://bit.ly/ServiceModule_DesignReview)

A test version of the Orion service module has been undergoing acoustic and vibration testing at NASA Glenn Research Center's Plum Brook Station in Sandusky, Ohio.





On June 8, NASA astronaut and Orion representative Rick Mastracchio visited the Airbus Defence and Space team in Bremen, Germany and spoke to students in Bremen about the challenges of living and working in space. A veteran of four spaceflights, Mastracchio flew as a mission specialist on STS-106, STS-118, STS-131 and as a flight engineer on International Space Station Expeditions 38 and 39. (above)



The Orion spacecraft and its European-built service module were showcased at this year's ILA 2016 airshow in Berlin, Germany. The event was hosted by Airbus Defence





The team at L-3 Cincinnati Electronics poses for a photo.



U.S. Senator Rob Portman addresses employees at Metalex Manufacturing in Blue Ash, Ohio, during an All Hands presentation from Orion and SLS teams (above) and the team at Metalex Manufacturing poses for a photo (below).



## OHIO SUPPLIERS COMMENDED BY SENATOR PORTMAN

U.S. Senator Rob Portman delivered remarks to employees and industry leaders at Orion and Space Launch System (SLS) supplier Metalex Manufacturing in Blue Ash, Ohio, on June 1. Orion and SLS management from NASA, Lockheed Martin, Boeing, Aerojet Rocketdyne and Orbital ATK recognized Metalex's contributions to NASA with a Space Flight Awareness Supplier Award. Metalex precision machines parts for the Orion crew module pressure vessel and the SLS RS-25 engine and rocket boosters.

L-3 Cincinnati Electronics, also an Orion/SLS supplier, was visited the next day by the team. L-3 provides expertise in avionic components for both Orion and SLS.

Read all about it in the news features below:

[bit.ly/Ohio\\_FutureSpace](http://bit.ly/Ohio_FutureSpace)

[bit.ly/MetalexInspiresYouth](http://bit.ly/MetalexInspiresYouth)

[bit.ly/ThankYouBlueAsh](http://bit.ly/ThankYouBlueAsh)

[bit.ly/OhioVisit\\_Orion](http://bit.ly/OhioVisit_Orion)





# ORION AND SLS PROGRAMS THANK ALABAMA WORKFORCE

NASA Orion managers visited with Alabama suppliers KT Engineering and SEA Wire & Cable in Madison and Micor Industries in Decatur following a presentation to Orion and SLS employees working at NASA's Marshall Space Flight Center in Huntsville. Several Orion Program Manager Commendations were awarded during the events.

Congratulations to NASA's Marshall Space Flight Center Orion Program Commendation winners Melinda McCord and Terry Abel. (above)

KT Engineering developed the designs for the Orion crew module assembly fixture, handling adapters and launch abort system support pallets. (right)

The SEA Wire & Cable team shows their pride in space exploration. The woman-owned small business has about 90 employees and was founded in Madison, Alabama, in 1970. The company supports NASA's Orion and SLS programs. (below)







The team at MICOR Industries in Decatur, Alabama, shows off the completed Exploration Mission-1 environmental control life support system palette. Micor Industries machines many of the brackets that go on the Orion crew module.







# PLUM BROOK STATION: POWERING UP FOR THE NEXT 75 YEARS

In celebration of its 75th anniversary, NASA's Glenn Research Center welcomed more than 15,000 visitors at an open house event for its Plum Brook Station in Sandusky, Ohio. Attendees enjoyed exhibits, hands-on activities and tours of Plum Brook's space environment test facilities, including the Space Power Facility, which is currently testing Orion's European Service Module structural test article.

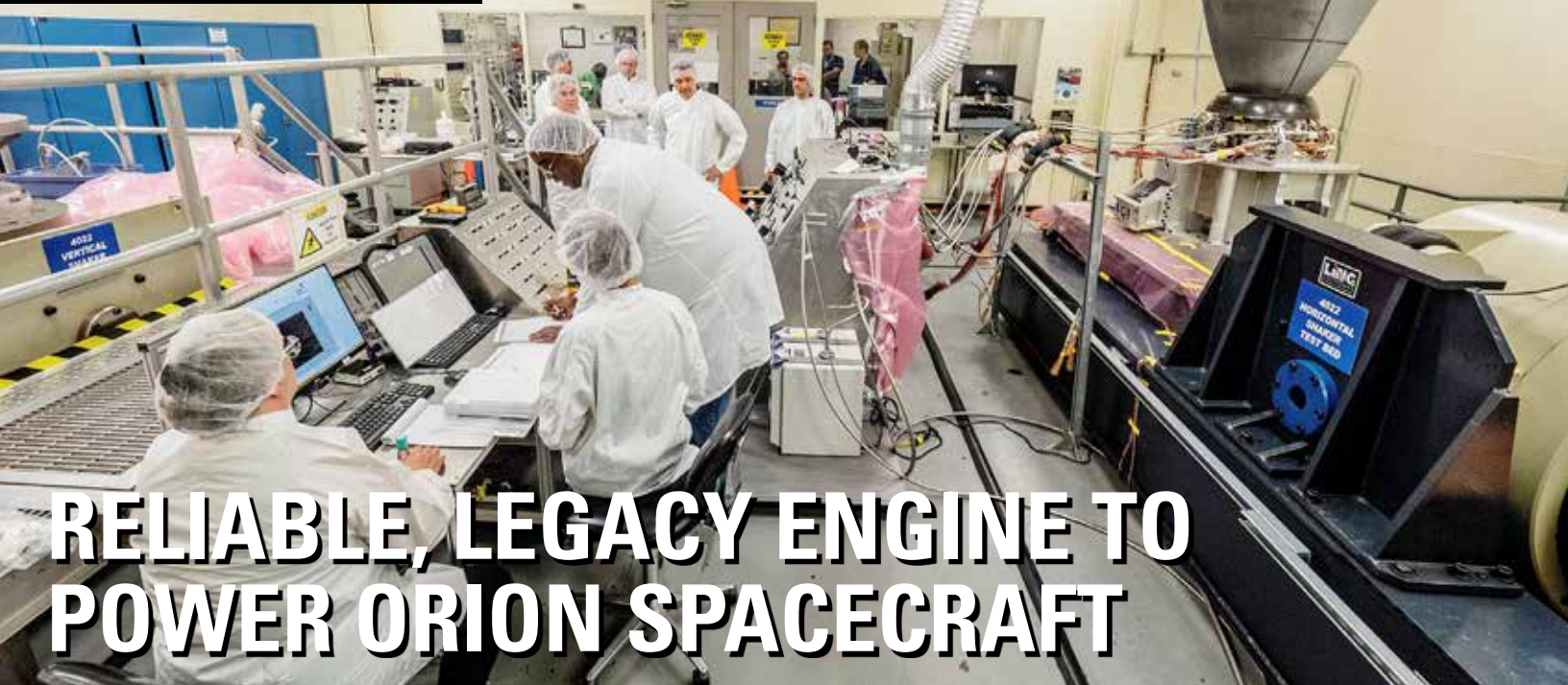
The Space Power Facility houses the world's largest space simulation thermal-vacuum chamber, the world's most powerful reverberant acoustic test chamber, the world's highest capacity and most powerful mechanical vibration test stand, and the world's largest reverberant-mode electromagnetic interference/electromagnetic compatibility (EMI/EMC) test capability.

The 6,400-acre Plum Brook Station was originally developed by the War Department in the 1940s for ordnance production for World War II, then used by the National Advisory Committee for Aeronautics in the 1950s to design for nuclear-powered aircraft. NASA adopted Plum Brook in the 1960s with intent to test nuclear-powered spacecraft in simulated space environments, but that never occurred. Since then, Plum Brook's Space Power Facility has tested numerous spacecraft systems, such as fairings, space station radiators, Mars lander airbags, and solar sails.

The Orion spacecraft test series at Plum Brook Station spans across all vehicles and test articles from the structural test article to the Exploration Mission-1 vehicle. These series include acoustic testing, solar array deployment tests, thermal vacuum and thermal balancing testing, and EMI/EMC.



An Orbital Maneuvering System engine that will help propel Orion while in space is undergoing vibration testing at the NASA's Johnson Space Center in Houston.



# RELIABLE, LEGACY ENGINE TO POWER ORION SPACECRAFT



An Orbital Maneuvering System engine is outfitted at NASA's Johnson Space Center in Houston before shipment to NASA's White Sands Test Facility in New Mexico.



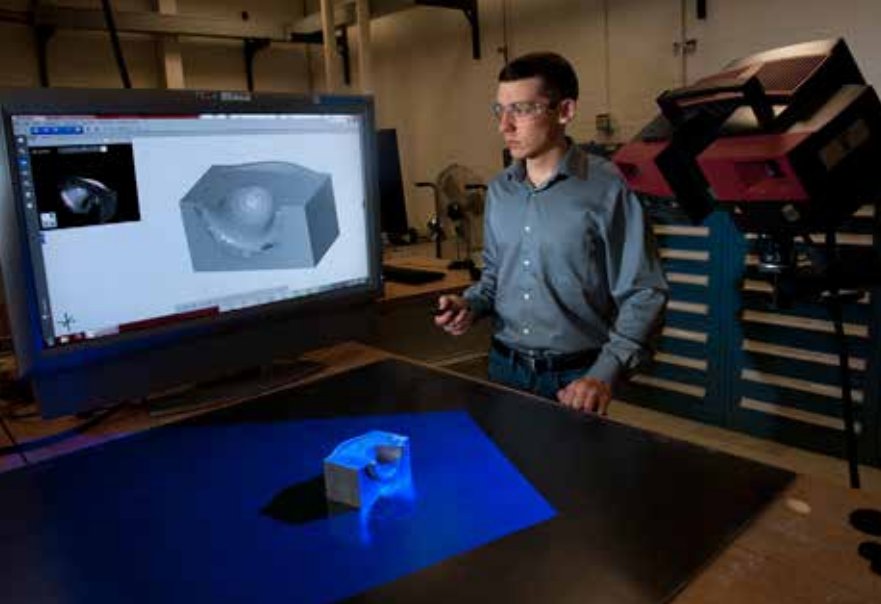
For more than 50 years, NASA has built upon the trials, tribulations and successes of all its human spaceflight missions to safely evolve to today's more ambitious and demanding missions required for the journey to Mars.

Engineers at NASA's Johnson Space Center in Houston are conducting vibration tests on an Orbital Maneuvering System engine used on the space shuttle before shipping it to the agency's White Sands Test Facility in New Mexico, where it will be fired to qualify the engine for use on Orion's service module. The vibration testing will help ensure the engine can withstand the loads induced by launch on the agency's SLS rocket. This summer, another Orbital Maneuvering System engine will be tested at Johnson before it is supplied to ESA to integrate into Orion's service module, which will power, propel and cool Orion in space, and also provide consumables like air and water for future crews.

ESA and its contractor Airbus Defence & Space are providing the service module for Exploration Mission-1, a 2018 mission of the Orion spacecraft and SLS rocket that will send the spacecraft about 40,000 miles beyond the moon. This Orbital Maneuvering System engine was used on the space shuttle to provide the thrust for orbital insertion, orbit circularization, orbit transfer, rendezvous, deorbit and abort situations and flew on 31 shuttle flights. The engine flying on Exploration Mission-1 flew on 19 space shuttle flights, beginning with STS-41G in October 1984 and ending with STS-112 in October 2002.

Read the full story at: [bit.ly/SMEngine\\_ShakeTest](http://bit.ly/SMEngine_ShakeTest)





## 3D SCANNER PROVIDES AS-BUILT SERVICE MODULE ENGINE MEASUREMENTS FOR ORION

A former shuttle Orbital Maneuvering System (OMS) engine, modified for its new role supporting Orion's European-built service module, was recently digitized and measured by NASA's White Sands Test Facility Materials and Components Laboratories Office to identify port and wire harness positions for external customers. Alaskan native and Eastern New Mexico University materials engineering graduate Jordan Wladyka performed the scan using the Advanced Topometric Optical Sensor II 3-D digitizer to ensure the engine, in its current state of construction, will interface correctly with components fabricated across the country. The projection-based scanner produces highly accurate files that can easily be imported into solid modeling software. Critical component mating interfaces were measured with an accuracy better than 27 microns (0.002 in.). In later scans the OMS engine heat shield and oxidizer inlet were also digitized.



## NASM HOSTS SPACE DAY EVENT

On June 4, NASA Orion's C.J. Johnson (pictured here) and Lockheed Martin Space Systems' David Brandt spoke with visitors at the annual Space Day event at the National Air and Space Museum in Washington, D.C. The educational event included hands-on activities, "Meet an Astronaut" sessions, and show and tell presentations by NASA and museum staffers.



# TOP STUDENTS LEARN FROM NASA

Texas high school students with the highest scores stemming from a 16-week High School Aerospace Scholars online curriculum were selected to visit NASA Johnson for one week to learn more about space exploration. Along with their web-based training they have the opportunity to hear from a NASA Orion engineer for each session. Orion engineers Dustin Neill (Lockheed Martin Space Systems) and Nujoud Merancy (NASA), were the first to speak to students at Space Center Houston in front of the Orion mockup.



## NASA VISITS STUDENTS

On May 16, Orion engineer David Dannemiller spoke with students at Antioch Elementary School's third grade class in Crestview, Florida. During the presentation, the students followed the progress of the International Space Station as it orbited the Earth, watched videos of Orion flight tests, discussed Sun/Earth/Mars size and distances, made a packing list of the items students would bring on a trip to Mars, and made and flew paper airplanes.



# EXPRESS THE EXPLORER IN YOU

Interplanetary travel enthusiasts can now show their true colors with NASA's new series of posters. You can colorize your cubicle, Orion-ize your office or redecorate your room with these colorful posters now available for download and print-on-demand.

Hike the solar system's largest canyon, see the two moons of Mars (Phobos and Deimos) in the night sky, and journey across strange new worlds through these visual vistas.

More styles and other collectibles available at:

[bit.ly/Mars\\_Posters](http://bit.ly/Mars_Posters) and [bit.ly/Orion\\_Collectibles](http://bit.ly/Orion_Collectibles)



## FOLLOW THE PROGRESS OF NASA'S NEW SPACECRAFT FOR HUMAN EXPLORATION:

**NASA's Orion Blog** . . . . [Blogs.NASA.gov/Orion](http://Blogs.NASA.gov/Orion)  
**Twitter** . . . . . [Twitter.com/NASA\\_Orion](http://Twitter.com/NASA_Orion)  
**Facebook** . . . . . [Facebook.com/NASAO Orion](http://Facebook.com/NASAO Orion)  
**Flickr** . . . . . [Flickr.com/NASAO Orion](http://Flickr.com/NASAO Orion)  
**Google+** . . . . . [Plus.Google.com/+NASA Orion](http://Plus.Google.com/+NASA Orion)

## JULY

Avcoat flight tile manufacturing at Michoud  
Launch Abort System motor testing  
California supplier visits  
EAA AirVenture in Oshkosh, Wisconsin





JUNE 2016

# SPACE LAUNCH SYSTEM

## HIGHLIGHTS

**SLS BOOSTER  
FIRES UP FOR  
LAST TEST  
BEFORE  
FIRST FLIGHT**



# SPACE LAUNCH SYSTEM BOOSTER PASSES MAJOR MILESTONE ON JOURNEY TO MARS

A booster for the most powerful rocket in the world, NASA's Space Launch System, successfully fired up June 28 for its second qualification ground test at Orbital ATK's test facilities in Promontory, Utah. This was the last full-scale test for the booster before SLS's first uncrewed test flight with NASA's Orion spacecraft in late 2018, a key milestone on the agency's journey to Mars.

"This final qualification test of the booster system shows real progress in the development of the Space Launch System," said William Gerstenmaier, associate administrator for the Human Exploration and Operations Mission Directorate at NASA Headquarters in Washington. "Seeing this test today, and experiencing the sound and feel of approximately 3.6 million pounds of thrust, helps us appreciate the progress we're making to advance human exploration and open new frontiers for science and technology missions in deep space."

The booster was tested at a cold motor conditioning target of 40 degrees Fahrenheit – the colder end of its accepted propellant temperature range. When ignited, temperatures inside the booster reached nearly 6,000 degrees. The two-minute, full-duration ground qualification test provided NASA with critical data on 82 qualification objectives that will support certification of the booster for flight. Engineers now will evaluate these data, captured by more than 530 instrumentation channels on the booster.

"This test is the pinnacle of years of hard work by the NASA team, Orbital ATK and commercial partners across the country," said John Honeycutt, SLS Program manager at NASA's Marshall Space Flight Center in Huntsville, Alabama. "SLS hardware is currently in production for every part of the rocket. NASA also is making progress every day on Orion and the ground systems to support a launch from Kennedy Space Center in Florida. We're on track to launch SLS on its first flight test with Orion and pave the way for a human presence in deep space."

More information on the second booster qualification test can be found here:

[What is QM-2?](#)

[Boosters 101](#)

[Three Cool Facts about QM-2](#)

[Behind the Scenes at QM-2](#)





# SNAPSHOT OF SLS BOOSTER TEST



*The house is rolled back ahead of the second and final qualification motor (QM-2) test for the SLS booster at Orbital ATK's test facility in Promontory, Utah.*



*Space Camp trainees get ready to watch the SLS booster fire up for testing during a special viewing at the U.S. Space & Rocket Center in Huntsville, Alabama.*



*More than 5,000 people came out to watch the SLS booster test at the public viewing area in Promontory, Utah.*



*Spectators watch as the booster fires up for a two-minute test.*



*Former NASA astronaut Don Thomas takes questions from excited children at the Boys and Girls Club of Northern Utah.*



*Say "Booster!" An enthusiastic family gets a photo made at the public viewing area before the SLS booster test.*



# QM-2 SOCIAL SNAPSHOT

#SLSFiredUp trended throughout the day in the United States on Twitter and Facebook.



# #SLSFiredUp



Marshall Center Director Todd May talks to the 33 NASA Social participants who got the opportunity to tour Orbital ATK facilities and see the booster test in person. The group shared their experiences on their social media accounts, using the hashtag #SLSFiredUp. The hashtag trended on Twitter and Facebook.



The NASA Social group gets a closer look at the SLS booster after a successful test.

## SLS BOOSTER TEST IN THE NEWS

Washington Post

Daily Mail

NBC News

CNN Money

Popular Mechanics

CBS News

USA Today

Popular Science

Reuters

Ars Technica

The Huffington Post

BBC



# HARDWARE FOR NASA'S JOURNEY TO MARS IS 'BIG CATCH' FOR UPCOMING TEST SERIES

A key piece of hardware for SLS completed a five-hour journey by barge June 19 along the Tennessee River in North Alabama. Fishermen may have caught a glimpse of it on its way from United Launch Alliance in Decatur, Alabama, to the agency's Marshall Space Flight Center in Huntsville, Alabama.

The transported hardware is a prototype of the interim cryogenic propulsion stage (ICPS) and will be a "big catch" for testing later this year. Read more [here](#).



*The interim cryogenic propulsion stage test article made a five-hour journey on the Tennessee River from United Launch Alliance in Decatur to the Marshall Center.*



Two cranes lift the interim cryogenic propulsion stage test article out of its crate. The ICPS test article joins other structural test articles and simulators that make up the upper portion of the SLS rocket. They will be stacked and tested later this year at Marshall.

# NASA IN THE PARK



*More than 7,500 people attended NASA Marshall Space Flight Center and Downtown Huntsville, Inc.'s third annual celebration of NASA and the community June 18. This year, the event moved to Huntsville's Big Spring Park, becoming "NASA in the Park." SLS was part of the celebration, which featured fun for all ages. [See more pictures](#) from "NASA in the Park."*

# SLS INSPIRES AT 'TAKE YOUR CHILDREN TO WORK DAY'



*Saniyah Jones, daughter of Sophia Jones and granddaughter of SLS's Stephanie Lacy-Conerly, greets an "astronaut" at the Marshall Center's "Take Your Children to Work Day." More than 500 potential future spacefarers, scientists and engineers took part in the event June 23, which included SLS exhibits and activities.*



# FACES OF SLS: JANICA CHENEY

*This rocket scientist is the conductor of one big orchestra for testing the boosters that will help NASA's Space Launch System hit the "high note" of deep space. Meet Janica Cheney, director of test and research operations at Orbital ATK.*



## SPACEFLIGHT PARTNERS: *Metalex Inc.*



*Metalex employees are recognized June 1 for their work on SLS and Orion during a NASA supplier visit to the manufacturing facility.*



### LOCATION:

*Blue Ash, Ohio*

**NUMBER OF EMPLOYEES: 120**

### WHAT THEY DO FOR SLS:

Metalex is currently under contract to Aerojet Rocketdyne, Boeing and Orbital ATK to machine critical components for the SLS rocket's liquid rocket engines, solid rocket boosters and propellant systems. This includes critical RS-25 engine components, such as the main combustion chamber, powerhead and the main injector inner propellant plate. In June, the company was recognized with a Space Flight Awareness award for its contributions toward the SLS Program, and achieving its affordability and schedule goals.



# MICHOUD 'TANKS' UP FOR NASA'S DEEP SPACE ROCKET



A qualification article for the SLS liquid hydrogen tank undergoes welding in the Vertical Assembly Center at Michoud. At the same time, a crew completes installation and checkout procedures for the liquid oxygen tank weld confidence article, bottom left. The liquid hydrogen and liquid oxygen tanks make up the SLS core stage. Confidence hardware verifies weld procedures are working as planned and tooling-to-hardware interfaces are correct. The confidence article also will be used in developing the application process for the thermal protection system, which is the insulation foam that gives the tank its orange color. The liquid hydrogen qualification article closely replicates flight hardware and processing procedures. Once completed, both tanks later will be shipped on the Pegasus barge to the Marshall Center for structural loads testing on two new test stands currently under construction for the tanks.

# BILL NELSON SEES MANUFACTURING OF SLS FUEL TANK AT MICHOUD



In June, Sen. Bill Nelson (D-FL), center, along with NASA officials, got a look inside a liquid hydrogen tank test article being constructed by the world's largest robotic weld tool in the Vehicle Assembly Center at NASA's Michoud Assembly Facility in New Orleans. At over 300-feet tall and 5.75 million pounds at liftoff, SLS needs plenty of fuel to leave Earth. Once a final dome is added to the liquid hydrogen rocket fuel tank, shown here, it will come in at 27.5-feet in diameter and over 130-feet long.

# SLS HITS A HOME RUN WITH BASEBALL FANS

The 30-foot-tall inflatable SLS was a grand slam for thousands of spectators at the Congressional Baseball Game June 23 at Nationals Park in Washington. ►





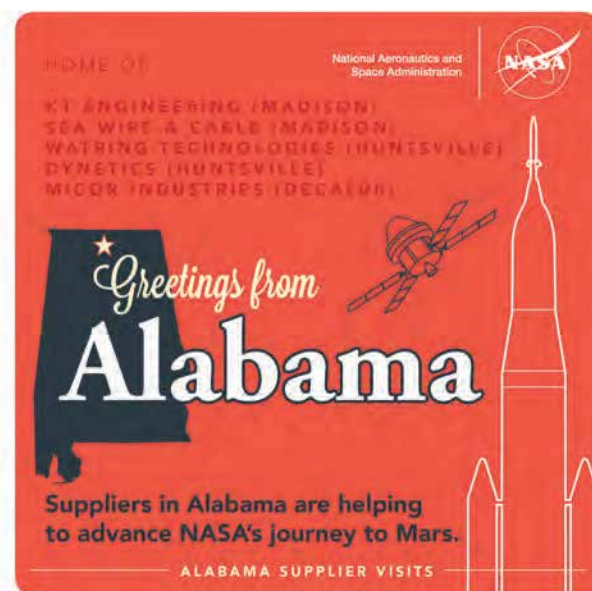
# SLS VISITS OHIO AND ALABAMA PARTNERS



SLS Boosters Deputy Manager Bruce Tiller thanks employees at L-3 Cincinnati Electronics in Mason, Ohio, for their work on avionics components for SLS and Orion. While in Ohio, NASA and prime contractor representatives also visited Metalex Manufacturing Inc. in Blue Ash. The company machines parts for the Orion crew module, and SLS RS-25 engine and rocket boosters.



Employees from Watring Technologies of Huntsville, Alabama, accept supplier awards for their work on SLS. NASA and several prime contractor companies visited four suppliers, including Watring, in the Huntsville/Madison area June 15-16. Supplier visits are intended to highlight and recognize the critical role companies across the country play in the production of the SLS and Orion.



## FOLLOW THE PROGRESS OF NASA'S NEW LAUNCH VEHICLE FOR DEEP SPACE:

NASA SLS Rocketology Blog....[blogs.nasa.gov/Rocketology](http://blogs.nasa.gov/Rocketology)  
 Twitter.....[Twitter.com/NASA\\_SLS](https://twitter.com/NASA_SLS)  
 Facebook.....[Facebook.com/NASASLS](https://facebook.com/NASASLS)  
 Flickr.....[Flickr.com/NASASLS](https://flickr.com/NASASLS)  
 Google+.....[Plus.Google.com/+NASASLS](https://plus.google.com/+NASASLS)  
 Tumblr.....[nasasls.tumblr.com](https://nasasls.tumblr.com)

## COMING IN JULY:

RS-25 development engine testing

LVSA flight aft ring machining complete

Transporters arrive at Marshall





# GSDO

GROUND SYSTEMS  
DEVELOPMENT & OPERATIONS

EXPLORATION BEGINS HERE



## PROGRAM HIGHLIGHTS • JUNE 2016

At NASA's Kennedy Space Center in Florida, the Ground Systems Development and Operations (GSDO) Program Office is leading the center's transformation from a historically government-only launch complex to a spaceport bustling with activity involving government and commercial vehicles alike. GSDO is tasked with developing and using the complex equipment required to safely handle a variety of rockets and spacecraft during assembly, transport and launch. For more information about GSDO accomplishments happening around the center, visit <http://www.nasa.gov/groundsystems>.

## NASA's Ground Systems Team Puts Students 'FIRST'

NASA's Ground Systems Development and Operations (GSDO) Program focuses primarily on preparing Kennedy Space Center in Florida to support future launches on the journey to Mars. But investing in that future extends beyond facilities and hardware; it also means reaching out to help students gain hands-on experience in robotics.

Funding provided by the GSDO Robotics Grant Program supports teams across Florida's Space Coast. This financial assistance allows new teams to form and helps existing teams cover the costs of registration, equipment, competitions, and travel when teams could not otherwise afford to move on in the competition season.

The program funds 29 FIRST Lego League teams (ages 9-14), 12 Florida Tech Challenge Teams (grades 7-12) and four FIRST Robotics Competition Teams. FIRST, meaning "For Inspiration and Recognition of Science and Technology," was founded in 1989 to encourage students' interest and participation in these fields.

The program's main objective in offering the grant is to motivate, educate and inform students of the importance and application of science, technology, engineering and mathematics. It also is GSDO's goal to inspire students, teachers, and the general public about NASA, the program itself, and how the world benefits from U.S. space exploration activities.

Team Manatee Law from Riviera Elementary School in Palm Bay, Florida, is exactly the sort of team GSDO sought to help when it created the grant program in 2014.

Manatee Law struggled to continue as their Title 1 School funding couldn't afford them a new robotics kit, and ultimately the team robot died during a competition and was irreparable.



Team Manatee Law pauses for a group photo during the 2016 qualifying tournament. Image Credit: Riviera Elementary/Team Manatee Law

The next year, Coach Lynette Rivera was granted a GSDO Rookie Team Grant to fund purchase of a brand new EV3 Robotics kit, a field setup and a laptop to allow the team to program their robot.

"What they did with that funding was nothing short of phenomenal," said Jennifer Levitt, GSDO grant program coordinator.

To read the complete story, visit <http://go.nasa.gov/2a3Gtgt>.



# Ground Systems Team Spotlight

**Teresa Parrish** is the export administrator with Jacobs on the Test and Operations Support Contract (TOSC) at Kennedy Space Center. She performs export control on behalf of NASA in support of the International Space Station Program, Exploration Systems Development teams, and NASA's Orion European Service Module team.



Her export duties include processing Department of State and Department of Commerce export licenses, NASA Government Exception Authorizations, and U.S. Department of Agriculture permits, fish and wildlife permits and U.S. Customs duty-free letters.

To support the Ground Systems Development and Operations Program (GSDO), Parrish obtained export licenses in support of the Orion European Service Module (ESM) structural test article, EM-1 flight activities, and reviewed the ground processing export requirements with the Orion ESM. She also categorizes all of the new TOSC GSDO designs and upgrades under the export regulations.

Parrish has worked at Kennedy for 28 years. She started at the NASA Shuttle Logistics Depot with Rockwell International supporting subcontract administrators with their contract agreements between shuttle vendors for parts, spares and repairs. She transferred to Security, where she administered Department of Defense security clearances, security background paperwork and badging. In 1986, Rockwell transitioned to United Space Alliance, and so did Parrish, where she started her endeavor with export compliance in 1999. She worked in security and then legal, where she worked on export licenses to share technology with each international partner to fly modules on the space shuttle to the International Space Station.

In February, she received a KSC Certificate

of Appreciation from Kennedy Center Director Bob Cabana for exceptional logistics (exporting) support to the International Space Station Program. Previously, she received a Space Flight Awareness Award for outstanding support with obtaining export licenses in support of the Alpha Magnetic Spectrometer payload that launched aboard space shuttle Endeavour on the STS-134 mission to the space station.

Parrish is originally from Springfield, Tennessee, and moved to Florida in 1985. She has a Bachelor of Science from Barry University and also has a postsecondary vocational certificate as an international business specialist.

Parrish has been married 27 years to her husband Craig. They have two children, a daughter who works in NASA Human Resources at Kennedy and a son in the U.S. Navy, stationed in Virginia Beach. They have a three-year-old grandson and a granddaughter due in September.

Her first car was a 1980 tan Toyota Celica with a hatchback.

Her hobbies include bike riding, walks on the beach and traveling on mission trips with her church to places like Montana, West Virginia and the Amazonas River in Brazil.

"I hope the U.S. will protect our new critical export-controlled technology that we develop on the new programs, and still discover spinoff technologies to share with businesses, and also make discoveries that will inspire Americans," Parrish said. "Maybe we'll find a cure for some medical disease or a cheaper way to fuel the world."

**Spiros Bourtis** is a mechanical engineer with SGT Inc. on the Engineering Services Contract (ESC) at Kennedy Space Center. He has worked at the center for seven years.

His main responsibility supporting the Ground Systems Development and Operations Program is serving as the lead design engineer for the Interim Cryogenic Propulsion Stage Umbilical (ICPSU) subsystem on the mobile launcher for the Space Launch System (SLS).

The ICPSU will provide liquid hydrogen and liquid oxygen, among other commodities, to fuel the second stage of the SLS Block 1 vehicle.

Bourtis says the coolest part of his job is working with the wonderful and supportive team at Kennedy, designing part of the new mobile launcher for the next generation of space exploration rockets, leading a team of engineers for the design and analysis of the ICPSU, and being able to develop ideas from concept to fabrication and testing.

"It was amazing to watch as the ICPSU arm was delivered to Kennedy and lifted

by crane up on the Launch Equipment Test Facility tower," Bourtis said. "I felt proud to have all of the years and long hours of design work from the ESC and NASA team come to fruition."

In 2014, Bourtis received a NASA Space Flight Awareness award for his efforts on the ICPSU. "I was very humbled to be recognized by my management and peers for my dedication to the project," Bourtis said.

Bourtis first became interested in space when he was four years old, during a family vacation to Florida and Kennedy Space Center. "I thought it was incredible to be able to explore and learn about our universe, so from that point on I made all my school projects about outer space," Bourtis said.

He earned three degrees from the Florida Institute of Technology in Melbourne: a Bachelor of Science in aerospace engineering, and Masters of Science in engineering management and systems engineering.

What are his hopes for NASA's space program and exploring beyond low-Earth orbit?

"I think that human exploration of our solar system is incredible and I hope to see



crewed rocket exploration increase exponentially throughout our solar system within my lifetime," Bourtis said.

Bourtis' first car was a 1994 red Pontiac Sunbird he owned during college days. He had written on the back of the car, "No really, I am a rocket scientist."

He is married to his wife, Carla, and they have one son, Stavros, who turned one on July 4th. They have a dog named Chloe, who is a rescued mixed breed.

Bourtis' hobbies include soccer, lacrosse, surfing, scuba diving, sailing and traveling.



# Industry Spotlight - Precision Fabrication Cleaning

Precision Fabrication & Cleaning (PFC) was founded in 1964 by co-owners Jack Shye and Russell Gray in Cocoa, Florida. The Precision group also includes Precision Mechanical Inc. and Precision Enterprises Inc. The company has satellite operations in Colorado and Virginia (supporting launch operations at Wallops Island).

Current owners are Robert Kelly, president; Todd Gray, vice president of operations; and Jason Shye, chief financial officer.

All three Precision companies have provided direct support to NASA since they were founded more than 50 years ago. PFC offers fabrication, chemical pretreatment, precision cleaning, testing and painting of panel frames, processing skids and ground support equipment to its customers. They also provide mobile and field cleaning capabilities, welding, corrosion control,

and extensive fabrication and assembly operations.

“Our fabrication, testing and installation projects include strict quality control, close interface and design troubleshooting with NASA,” said Deb Ehlers, Precision technical support.

Precision performs a myriad of support services to NASA and the Orion and SLS programs.

About 200 employees work at job sites in Florida, Virginia and Colorado facilities. They perform refurbishment of existing NASA hardware, vehicle hardware, and ground support equipment to meet Orion and Space Launch System (SLS) configuration requirements.

PFC currently is providing support to the Ground Systems Development and Operations Program and Engineering Directorate at Kennedy Space Center for the two Tail Service Mast Umbilicals (TSMUs).

At the Cocoa location, workers inspected, cleaned and assembled the TSMU components that will connect from the zero-level deck on the mobile launcher to the SLS rocket core stage aft section. The umbilicals will be prepared for transportation to Kennedy for testing at the Launch Equipment Test Facility.

PFC capabilities include a comprehensive machine shop with unique and high-tolerance tooling, cleaning and passivating operations to Kennedy standards.

“Precision will continue to provide fabrication, cleaning, testing and installation services for new projects as they are developed,” Kelly said. “We have a strong commercial project base and are uniquely positioned to continue growing, improving, and supporting government projects as they fluctuate during development phases.”



*A crane lowers a segment of one of the Tail Service Mast Umbilicals to its other segment at Precision Fabrication & Cleaning in Cocoa, Florida. Photo credit: NASA/Bill White*

Several connections, called launch umbilicals, will connect from the mobile launcher tower and provide power, communications, coolant and fuel to NASA's Space Launch System (SLS) rocket and Orion spacecraft for their first integrated mission. Among them are two umbilicals called tail service mast umbilicals (TSMUs). They are being cleaned and assembled at Precision Fabrication & Cleaning (PFC) in Cocoa, Florida, before they are transported to the agency's Kennedy Space Center in Florida for testing.

Technicians at PFC are cleaning the two segments of each umbilical to remove any dirt or debris that may hinder their functionality, checking them for any defects, and then assembling the parts to form two complete umbilicals. They will be transported to Kennedy's Launch Equipment Test Facility where they will undergo testing to ensure their readiness to support operations leading up to launch.

The umbilicals will connect from the zero-level deck on the base of the mobile launcher to the SLS rocket core stage aft section. The 33-foot-tall structures will provide liquid oxygen and liquid hydrogen fluid lines and electrical cable connections to the SLS core stage engine section to support propellant handling during prelaunch operations.

At the LETF, engineers and technicians will use liquid nitrogen to simulate the liquid oxygen for the TSMU that will provide liquid oxygen. They will test the umbilical's arm performance across the full range of SLS core stage motions and simulate a vehicle launch using the Vehicle Motion Simulator test fixture. The same series of tests will be performed with the second TSMU that will provide liquid hydrogen, using the actual liquid hydrogen commodity.

Before launch, both TSMUs will tilt back to ensure a safe and reliable disconnect and retract of all umbilical hardware away from the rocket during liftoff.

Kennedy's Engineering Directorate, along with the Ground Systems Development and Operations Program, are supporting processing activities of the umbilicals for missions to deep space including NASA's journey to Mars.



# Employee Spotlight - Joy Mosdell

Joy Mosdell is the schedule analyst lead with Millennium Engineering and Integration for the Ground Systems Development and Operations Program (GSDO) at Kennedy Space Center.

Her primary responsibility is leading the schedule team and all of the schedule analysts that support all of the divisions of GSDO. She directly supports the mission manager and the program manager in all things schedule-related. She works directly with the Space Launch System and Exploration Systems Divisions.

Mosdell worked a combination of 15 years at Kennedy and Cape Canaveral Air Force Stations. She worked on the Boeing Delta IV and Delta II programs, at the NASA Applied Technologies Laboratory, and supported the U.S. Air Force for 10 years.

"The coolest part of my job is being able to interact with almost everyone on the GSDO team," Mosdell said. "I also have the opportunity to work with the other programs as well."

Mosdell became interested in space while she was in the Air Force. She was a missile launch control officer stationed in Minot, North Dakota. She knew about the space shuttle but didn't really have a great concept of what else was launched from Florida. She received an assignment to work on the Delta II Program.

"When I came to the Space Coast, I was exposed to all of the different rocket programs and saw my first space shuttle launch," Mosdell said.

"That's when I decided that I wanted to stay here. I realized this is where I needed to be – in aerospace."

Mosdell's hometown is Cleveland, Ohio. She moved to Florida in February 2001.

She earned a Bachelor of Arts in Political Science from Miami University.

She earned a Master of Science in Public Administration from Central Michigan University in Mount Pleasant.

Mosdell is looking forward to the launch of NASA's Space Launch System rocket and Orion spacecraft in a couple of years.

"We've come so far in the past four years, from early designs to actually fabricating and testing. It would be great if NASA has a rocket that can do something that no one else has done. It's very exciting, and we're almost there," Mosdell said.

Her first car was an early 1990s Ford Escort.

She has been married to her husband, Brian, for nearly seven years. They have a four-year-old son, Jack.

Mosdell's hobbies include running in marathons. She loves to run and participates at least once a year. Her most recent marathon, in April, was in Paris, France. An upcoming marathon, in October, will be in Dublin, Ireland.



*A heavy load transport truck from Tillett Heavy Haul Inc., in Titusville, Florida, carrying the second half of the D-level work platforms, D North, for NASA's Space Launch System (SLS) rocket, arrives at the Vehicle Assembly Building (VAB) at Kennedy Space Center on June 27, 2016. The platform was delivered to the VAB staging area in the west parking lot. Photo credit: NASA/Bill White*